CLAIMS

What is claimed is:

1. A method of detecting a transmission from a primary cellular transmitter, the primary cellular transmitter transmitting on at least one channel frequency and being located in the vicinity of one or more secondary cellular transmitters, the method comprising the steps of:

recording transmissions at a particular location for a minimum period of time, the particular location being within a footprint of the primary cellular transmitter but also being subject to receiving transmissions from one or more secondary cellular transmitters, the minimum period of time being the amount of time necessary to ensure that at least one transmission from the primary cellular transmitter is recorded;

transforming the recorded transmissions from a time domain to generate a frequency domain representation of the recorded transmissions;

examining the frequency domain representation of the recorded transmissions by measuring the peak signal level at a particular offset from each channel frequency, the particular offset being the location that an unmodulated signal would appear from the frequency; and

identifying the largest peak signal as a transmission from the primary cellular transmitter.

2. The method of claim 1, wherein the transforming step includes performing a fast Fourier limited to a bandwidth of approximately 500Hz.

3. The method of claim 1, wherein the transmissions from the primary and secondary cellular transmitters are performed as transmission bursts and the transforming step includes performing a fast Fourier transform limited to a bandwidth of approximately 500Hz and a time period ranging from 1/2 to 2/3 of the time required to transmit a burst.

4. The method of claim 1, wherein the transmissions from the primary and secondary cellular transmitters periodically include an FCCH transmission and the minimum period of time is the time required to ensure the reception of at least one FCCH transmission from the primary cellular transmitter.

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5. The method of claim 1, wherein the cellular transmitters are based on the GSM technology and the step of recording transmissions at a particular location for a minimum period of time further comprises recording data for 89 TDMA bursts, with BCCH carriers determined by each carriers timing relative to the sample.

6. A method of detecting an FCCH transmission from a primary cellular transmitter, the primary cellular transmitter transmitting on at least one channel frequency and being located in the vicinity of one or more secondary cellular transmitter, the FCCH transmission being a known sequence, the method comprising the steps of:

recording transmissions at a particular location for a minimum period of time, the particular location being within a footprint of the primary cellular transmitter but also being subject to receiving transmissions from one or more secondary cellular transmitters, the minimum period of time being the amount of time necessary to ensure that at least one FCCH transmission from the primary cellular transmitter is recorded;

for each channel frequency, demodulating the recorded transmission and correlating the demodulated transmission against the known sequence;

measuring the peak signal of the results of each multiplication; and

identifying the largest peak signal as the FCCH transmission for the primary cellular transmitter.

7. A method of detecting the base station color code for a primary cellular transmitter, the primary cellular transmitter transmitting on at least one channel frequency and being located in the vicinity of one or more secondary cellular transmitter, the method comprising the steps of:

recording transmissions at a particular location for a minimum period of time, the particular location being within a footprint of the primary cellular transmitter but also being subject to receiving transmissions from one or more secondary cellular transmitters, the minimum period of time being the amount of time necessary to ensure that at least one forward control channel transmission from the primary cellular transmitter is recorded;

performing a fast Fourier transform on the recorded transmissions to generate a frequency domain representation of the recorded transmissions, the fast Fourier transform having a bandwidth of approximately 500Hz and a time period ranging from 1/2 to

2/3 of the burst time;

examining the frequency domain representation of the recorded transmissions to identify the peak signal level at a particular offset from each channel frequency and the start time, the particular offset being the location that an unmodulated signal would appear from the frequency;

identifying the largest peak signal as the forward control channel for the primary cellular transmitter;

locating the transmission of a synchronization burst, the synchronization burst being offset a certain amount of time from the start time; and

extracting the base station color code from the synchronization burst.

8. The method of claim 7, wherein two synchronization bursts are identified, each synchronization burst identifying a separate base station color code, further comprising the steps of:

examining the training sequence of the forward control channel burst associated with each synchronization burst;

if the forward control channel does not include the broadcast channel training sequence, then reject the base station color code as a candidate.

9. A method of detecting a forward control channel transmission from a primary cellular transmitter, the primary cellular transmitter transmitting on at least one channel frequency and being located in the vicinity of one or more secondary cellular transmitter, the forward control channel transmission be a string of zeros causing signal energy to appear at a particular offset from the channel frequency, the method comprising the steps of:

recording transmissions at a particular location for a minimum period of time, the particular location being within a footprint of the primary cellular transmitter but also being subject to receiving transmissions from one or more secondary cellular transmitters, the minimum period of time being the amount of time necessary to ensure that at least one forward control channel transmission from the primary cellular transmitter is recorded;

for each channel frequency, multiplying the recorded transmissions by a sine wave, the sine wave having a frequency that is equal to the channel frequency plus the

particular offset;

measuring the peak signal of the results of each multiplication and the start time;

identifying the largest peak signal as the forward control channel for the primary cellular transmitter;

locating the transmission of a synchronization burst, the synchronization burst being offset a certain amount of time from the start time; and

extracting the base station color code from the synchronization burst.

10. A method of optimizing channel configurations within a cellular network, the cellular network including a plurality of cells with each cell having at least one cellular transmitter, the method comprising the steps of:

recording transmissions at a plurality of locations within a particular cell of the plurality of cells for a minimum period of time, the minimum period of time being the amount of time necessary to ensure the recordation of essential information;

for each of the plurality of locations:

process the recorded transmissions to identify the cellular transmitter associated with each transmission;

identify the frequency and signal level of each transmission; and

if the frequency of a first transmission that is not associated with the cellular transmitter in the particular cell is equal to the frequency of a second transmission that is associated with the cellular transmitter in the particular cell, and the signal level of the first transmission exceeds a threshold value, then remove the frequency from one of the cellular transmitter that is not associated with the particular cell or the cellular transmitter that is associated with the particular cell.

11. The method of claim 10, wherein the step of processing the recorded transmissions to identify the cellular transmitter associated with each transmission comprises measuring the angle of arrival of the transmission and comparing the angle of arrival information with the particular location of the plurality of locations and the location of the cellular transmitter within each of the plurality of cells.

12. The method of claim 10, wherein the step of recording transmissions at a plurality of locations further comprises recording the longitude and latitude of each of the plurality of locations and the step of processing the recorded transmissions to identify the cellular transmitter associated with each transmission comprises comparing the longitude and latitude of the transmission for a particular location with the longitude and latitude of the transmitters.

13. The method of claim 10, wherein the signal transmission levels at each of the plurality of locations for each of the cellular transmitters in each of the plurality of cells is predicted, and the step of processing the recorded transmissions to identify the cellular transmitter associated with each transmission comprises comparing the measured signal strength with the predicted signal transmission levels.

14. The method of claim 10, wherein the locations of each of the plurality of the cellular transmitters is known relative to each of the plurality of locations, and the step of processing the recorded transmissions to identify the cellular transmitter associated with each transmission comprises utilizing the timing characteristics of the received transmission.

15. A method for calculating the capacity of a cellular network having a plurality of cells with at least one cellular transmitter in each of the plurality of cells, the method comprising the steps of:

receiving configuration information, the configuration information identifying the channel frequencies assigned to each cellular transmitter in the cellular network;

measuring the signal level of each cellular transmitter within the cellular network;

identifying an interference level within the cellular network by comparing the measured signal level of each cellular transmitter within the cellular network to identify any co-channel interference;

comparing the interference level within the network to a desired maximum level;

if the interference level exceeds the desired maximum level, decreasing the loading of the cellular network; and

if the interference level is less than desired maximum level increasing the loading of the cellular network.

16. The method of claim 15, further comprising the steps of:

estimating the signal strength of each of the plurality of cellular transmitters within the cellular network affected by altering the loading of the cellular network based on the configuration information and any changes to the configuration information necessary to alter the loading of the cellular network;

modifying the previously measured signal levels within the cellular network that based on the estimations;

identifying a new interference level within the cellular network by comparing the modified signal level of each cellular transmitter within the cellular network to identify any co-channel interference; and

continuing from the comparing step with the new interference level.

17. An apparatus for measuring the signal energy at a plurality of locations within a cellular network, the signal energy being transmitted by any of a plurality of cellular transmitters within the cellular network, the apparatus comprising:

a wide band receiver having a signal input and a down converter output;

a processing unit;

an analog to digital converter having an analog input coupled to the down converter output of the wide band receiver and a digital output coupled to the processing unit;

a memory device coupled to the processing unit;

a digital signal processor coupled to the processing unit and the memory device;

a program module including instructions that when executed by the processing unit enable the processing unit to be operative to tune the wide band receiver to a desired center frequency;

the wide band receiver being operative to receive a radio frequency signal and down convert radio frequency signal to an intermediate frequency signal;

the analog to digital converter being operative to receive the intermediate frequency signal and create a digitized representation of the intermediate frequency signal;

the processing unit being operative to receive the digitized representation of the intermediate frequency signal and store the digitized representation of the intermediate frequency signal into the memory device; and

the digital signal processing unit being operative to read the digitized representation of the intermediate signal from the memory device and extract system characteristic data, the system characteristic data at least identifying the frequency and signal strength of the frequency received at a particular location.

18. The apparatus of claim 17 wherein the wide band receiver is operative band limit the intermediate frequency signal to approximately 10 MHz.

19. A system for measuring the signal strength characteristics within a cellular network comprising:

a plurality of cellular transmitters, each cellular transmitter being operative to transmit an identifying signal, the identifying signal being separate from the signals transmitted for cellular communications within the cellular network;

at each of a plurality of locations within the cellular network, taking a wide band measurement of the signal energy; and

examining the measured signal energy for any identifying signals and for each such identifying signal, record the signal strength of the received identifying signal and based on the characteristics of the identifying signal, record the identity of the cellular transmitter.

20. An apparatus for measuring the signal energy at a plurality of locations within a cellular network, the signal energy being sourced by any of a plurality of cellular transmitters within the cellular network, the apparatus comprising:

a wide band receiver having a signal input and a down converter output;

a processing unit;

a memory device coupled to the processing unit;

a digital signal processor coupled to the processing unit;

a program module including instructions that when executed by the processing unit enable the processing unit to be operative to tune the wide band receiver to a desired channel;

the wide band receiver being operative to receive a radio frequency and down convert the radio frequency signal to an intermediate frequency signal;

the processing unit being operative to direct the intermediate frequency signal to the digital signal processing unit; and

the digital signal processing unit being operative to process the intermediate frequency signal to identify system characteristic data, the system characteristic data at minimum identifying cellular transmitter originating an identifying signal and signal strength of the identifying signal.

21. A method of detecting transmissions from a cellular transmitter, the cellular transmitter transmitting on at least one channel frequency, the method comprising the steps of:

recording transmissions at a particular location for a minimum period of time, the minimum period of time being the amount of time necessary to ensure that at least one transmission from the primary cellular transmitter is recorded;

transforming the recorded transmissions from a time domain to generate a frequency domain representation of the recorded transmissions;

examining the frequency domain representation of the recorded transmissions by measuring the peak signal level at a particular offset from each channel frequency, the particular offset being the location that an unmodulated signal would appear from the frequency; and

identifying the largest peak signal as an FCCH for the cellular transmitter.

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